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Energy Expenditure For Restriction Of Carbohydrate Or Fat In The Diet

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Opinion note

Recently, discussion on low carbohydrate diet (LCD) and calorie restriction (CR) have advanced. When carbohydrate is taken too much, body weight often gains. When carbohydrate is restricted, there are no acute increases of blood glucose and insulin level, leading to weight reduction. There are many patients with obesity and diabetes, in which some cases cannot stop taking much food or carbohydrate. This phenomenon seems to be one of the addiction statuses, which may be called a food addiction or carbohydrate addiction. Thus, this problem includes bio-psycho-social aspects, which would be dealt with adequate strategies [1].

As to the metabolism of carbohydrate, there has been some controversy. The point is the relationship between calories and nutrient types. It is roughly divided into two ways of theoretical concept.

One is the idea of "A calorie is a calorie". The energy metabolism is the same regardless of the origin of the macronutrients. Total of the calories (energy) that is currently taken and absorbed is important from clinical point of view. This leads to the concept of conventional calorie restriction [2].

A related paper has been recently reported by Gardner et al. [3]. The Diet Intervention Examining the Factors Interacting with Treatment Success (DIETFITS) randomized clinical trial (RCT) was studied with 609 adults with BMI 28 -40 without diabetes. DIETFITS was studied in Stanford University. There are two groups, which are a healthy low-fat (HLF) diet vs a healthy low-carbohydrate (HLC) diet, and weight change was studied. Weight change at 12 months was -5.3 kg in HLF and -6.0 kg in HLC without significant differences in 2 groups. Further, the results were that neither genotype pattern nor baseline insulin secretion was found with the dietary effects on weight loss.

On the other hand, there is the concept of "calorie is not a calorie". This is a theory that the metabolism differs depending on the source of which nutrients even though the total of the calories (energy) is the same, and the influence on the living body is different. This leads to the basal idea of LCD. Recently, there is a new report that recommends carbohydrate-restricted diet as an adequate meal for the obesity [4]. It is RCT research by Harvard University, which is Framingham State Food Study (FSFS). Even with the same amount of energy intake, the carbohydrate-restricted diet was found to have higher energy expenditure. There was a comparison between carbohydrate-restricted dietand lipid-restricted diet, indicating the former is advantageous for obesity dissolution [4].

Their group recently advocated a new obesity theory "carbohydrate-insulin model" which is the opposite theory of conventional theory [5]. They consider that only weight reduction in short-term is not so difficult for obese people, while the important thing is not to cause rebound after weight reduction. Furthermore, they reported RCT study to compare LCD, CRand low glycemic index (GI) meal after weight reduction [6].

From the series of research mentioned above, the group of researchers has concluded as follows. According to the concept of carbohydrate-insulin model, energy consumption can be increased by restricting carbohydrate intake. Based on this new medical concept, continuing LCD would be effective. Especially in cases of obesity with hyperinsulinemia, there is rather high possibility for successful weight reduction by LCD treatment [4].

In previous comparative study between LCD and CR, the efficacy of LCD was superior to that of CR [7]. LCD was same and/or superior to the meal with balanced meal and same calorie [8]. Further, effect of very-low-carbohydrate ketogenic diets (VLCKD) for weight loss was shown on 6 months [9] and LCD with higher protein showed superior clinical effect [10].

As described above, two reports would be compared. In the former DIETFITS, there was not significant difference in body weight reduction between the carbohydrate-restricted diet and the high-carbohydrate diet. In contrast, the latter FSFS showed that the carbohydrate-restricted diet has superior effect in weight reduction. Then various related factors would be considered and investigated.

Firstly, the weight change is determined by the difference between energy intake and energy consumption. In the latter FSFS, test food intervention is fixed and total energy is fixed [4]. Then, weight change is determined by the difference from energy consumption, due to the influence of weight and physique. Furthermore, for statistical reasons, it is raised that energy

consumption in each subject shows large standard difference, and significant difference cannot be found so easily. Because statistical evaluation for a certain period intervention may be not easy, short-, medium- and long-term analysis should be conducted and comprehensive judgment will be required.

Secondly, research methods should be considered. Regarding a study on humans, providing a certain injections and medications per os can be continued for some period successfully, because this protocol is usually performed without any unexpected trouble or accident. On the other hand, actual study concerning meals in daily life cannot be strictly fixed, because the subjects are always engaged in their social life with family and other people including various opportunities.

The third is the influence and effect from several hormones. Conventionally, gastrointestinal hormones have been known that affect human feeding behavior and mechanism. Among these, Ghrelin enhances appetite, whereas GLP-1, GIP, peptide YY (PYY) decrease appetite from previous investigation [11]. In this regard, for FSFS study, LCD was the one that most suppressed the secretion of Ghrelin. As toGLP-1, GIP, PYY, there is a comparative study of LCD and CR (low-fat diet) [12]. Hall et al. conducted a crossover comparative test and reported that these three hormone levels were raised or maintained by LCDintervention [12]. From these, it seems that LCDs are equal or superior to CR from the viewpoint of hormones.

It is suggested that such a hormonal secretion kinetics is one of the factors contributing to increased feeling of satiety in LCD, and that the intake energy is maintained within the proper range due to satisfaction feeling.

In summary, there seems to be food addiction or carbohydrate addiction in the world. Along with the progress of clinical research on LCD and CR, there is a transition of the concept from "A calorie is a calorie" to "A calorie is not a calorie". Participation of hormone including Ghrelin, GLP-1, GIP, PYY, are also contributing to the clinical advantage of LCD. Further Investigation for this field will bring development in medicine, medical practice and society in the future.

Keywords: Energy Expenditure; Calorie Restriction (CR); Low Carbohydrate Diet (LCD); Carbohydrate Addiction; Ghrelin; Calorie Is Not A Calorie;

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